B.Sc. Forensic Science

Choice Based Credit System (2019-20 onwards)

CURRICULUM AND SYLLABUS

Department of Chemistry

SCHOOL OF ADVANCED SCIENCES

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION

(Deemed to be University)

Anand Nagar, Krishnankoil - 626 126

Virudhunagar District, Tamil Nadu

B.Sc. Forensic Science Curriculum

Semester	Course Category	Course Code	Course Name	L	T	P	C
I	Language (English)	BAE17R111	Poetry, Short Stories, Fiction, Grammar, Composition and Vocabulary	3	0	0	3
	*AECC-I	CHY17R103	Environmental Science	2	0	0	2
	Core course-I	FRS19R121	Introduction to Forensic Science	4	0	4	6
	Core course-II	FRS19R122	Criminalistics	4	0	4	6
	**GE-I	-----	Generic Elective / Interdisciplinary-I	4	0	4	6
			Total	**17**	**0**	**12**	**23**
II	Language	BAE17R112/ BAE17R151	Tamil / Hindi	3	0	0	3
	Core course-III	FRS19R123	Criminal Law	4	0	4	6
	Core course-IV	FRS19R124	Technological Methods in Forensic Science	4	0	4	6
	**GE-II	-----	Generic Elective / Interdisciplinary-II	4	0	4	6
	*AECC-II	BAE17R107	Communicative English	2	0	0	2
			Total	17	**0**	**12**	**23**
III	Core course-V	FRS19R221	Forensic Serology	4	0	4	6
	Core course-VI	FRS19R222	Forensic Dermatoglyphics	4	0	4	6
	**GE-III	-	Generic Elective / Interdisciplinary-III	4	0	4	6
	#AEEC-I	FRS19RSXX	Ability Enhancement Elective Course-I	2	0	0	2
			Total	**14**	**0**	**12**	**20**
IV	Core course-VII	FRS19R223	Forensic Chemistry	4	0	4	6
	Core course-VIII	FRS19R224	Forensic Biology	4	0	4	6
	**GE-IV	-	Generic Elective / Interdisciplinary-IV	4	0	4	6
	#AEEC-II	FRS19RSXX	Ability Enhancement Elective Course-II	2	0	0	2
	Training/Internship	FRS19R299	Analytical Lab Training / Internship	0	0	0	4
			Total	14	**0**	**12**	**24**
V	Core course-IX	FRS19R321	Forensic Ballistics	4	0	4	6
	##DSE-I	FRS19R33X	Discipline Specific Elective-I	4	0	4	6
	##DSE-II	FRS19R33X	Discipline Specific Elective-II	4	0	4	6
			Total	**12**	**0**	**12**	**18**
VI	Core course-X	FRS19R322	Forensic Toxicology	4	0	4	6
	##DSE-III	FRS19R33X	Discipline Specific Elective-III	4	0	4	6
	##DSE-IV/Project (or) Dissertation	FRS19R33X/ FRS19R399	Discipline Specific Elective-IV / Project (or) Dissertation	4	0	4	6
			Total	**12**	**0**	**12**	**18**

* Ability Enhancement Compulsory Course (AECC) ** Generic Elective

Ability Enhancement Elective Course (AEEC) ## Discipline Specific Elective

Elective Courses

A.	**Discipline Specific Electives (DSE)**	**B.**	**Generic Elective/Interdisciplinary (GE)**
Two each in Semester V and VI. To be chosen from the following:		One each in Semester I, II, III & IV. To be chosen from the following.	
FRS19R331	DSE-1: Digital Forensics	PHY18R176	GE-1: Physics
FRS19R332	DSE-2: Economic Offences	CHY19R143	GE-2: Chemistry
FRS19R333	DSE-3: Forensic Psychology	FRS19RG06	GE-3: Computer Science
FRS19R334	DSE-4: Accident Investigations	FRS19RG07	GE-4: Economics
FRS19R335	DSE-5: Crime and Society	FRS19RG03	GE-3: Botany
FRS19R336	DSE-6: DNA Typing	FRS19RG04	GE-4: Zoology
FRS19R337	DSE-7: Questioned Documents	FRS19RG05	GE-5: Anthropology
FRS19R338	DSE-8: Forensic Anthropology	FRS19RG08	GE-8: Psychology
FRS19R339	DSE-9: Forensic Medicine		
FRS19R399	DSE-10: Dissertation (in Semester VI only)		

Ability Enhancement Courses

1.	**Ability Enhancement Compulsory Courses (AECC)**	**2.**	**Ability Enhancement Elective Courses (Skill Based) (AEEC)**
One each in Semester I and II. To be chosen from the following.		One each in Semester III and IV. To be chosen from the following.	
CHY17R103	AECC-1: Environmental Science	FRS19RS01	AEEC-1: Introduction to Biometry
BAE17R107	AECC-2: English/MIL Communication	FRS19RS02	AEEC-2: Handwriting Identification and Recognition
		FRS19RS03	AEEC-3: Forensic Science and Society

Non-CGPA Courses

Group	Sl.No.	Course	Credit(s)	Minimum Requirements
I	1.	NCC	3	**9 Credits** (3 credits from Group I and 6 credits from Group II)
	2.	NSS	3	
	3.	Sports	3	
II	4.	Co-curricular activities	3	
	5.	Certification Course (Tally, JAVA etc.)	3	
	6.	English proficiency certification (TOEF/IELTS/BEC)	3	
	7.	Foreign Languages (French/ German /Japanese /Korean etc.)	3	
	8.	Extra-Curricular Activities (Association & Club Activities) [YRC, Nature Club, Fine Arts, Photography Club, Yoga etc.]	3	

Consolidated Credits

Semester	Credits
I	23
II	23
III	20
IV	24
V	18
VI	18
Total Credits	**126**
Non-CGPA	**9**
Grand Total	**135**

FIRST YEAR

SEMESTER-I

BAE17R111	Poetry, Short Stories, Fiction, Grammar, Composition And Vocabulary	L	T	P	C
		3	0	0	3

Course Outcome(s)	
CO1	To introduce World renowned poets to students.
CO2	To make them understand the nuances of Short stories.
CO3	To acquaint students with the writings of Nobel laurates.
CO4	To excel in Grammar.
CO5	To excel in Composition.

Unit-I: Poetry **9 Hrs**

Nissim Ezekiel – Night of the scorpion
Robert Frost – Road Not Taken
Percy Bysshe Shelley – Ode to the West Wind

Unit-II: Short Stories **9 Hrs**

Jesse Owens - My Greatest Olympic Prize
R.K.Narayan – An Astrologer's Day
Stephen Leacock – My Financial Career

Unit-III: Fiction **9 Hrs**

Ernest Hemingway – The Old man and the Sea

Unit-IV: Grammar **9 Hrs**

a) Tenses
b) Nouns – Countable and Uncountable
c) Kinds of Sentences
d) Articles
e) Prepositions

Unit-V: Composition and Vocabulary **9 Hrs**

1. **Composition**
   a) Letter Writing (Formal and Informal)
   b) Curriculum Vitae
   c) Situational Conversation

2. **Vocabulary**

One Word Substitutes:

Alimony, amateur, amnesty, anaesthesia, anarchist, anatomy, anonymous, archive, atheist, autobiography, cannibal, carcinogen, cardiologist, carnivorous, centenarian, contemporary, connoisseur, cosmopolitan, crew, detective, (21 – 40) emigrant, epitaph, extempore, fauna, feminist, fleet, flora, forgery, gymnasium, gynaecologist, herbivorous, hypocrisy, incorrigible, kleptomania, lexicographer, manuscript, mercenary, misanthrope, mortuary, novice, (41 – 60) obituary, omniscient, ophthalmologist, optimist, omnipotent, orphan, panacea, parasite, pedestrian, pessimist, philanthropy philatelist, polygamy, posthumous, post-mortem, secular, somnambulist , theology, unanimous, utopia.

Text Books:

1. Sadanand Kamalesh. & Punitha, Susheela. Spoken English: A Foundation Course, Part 2 Orient Black Swan, New Delhi, 2011
2. Taylor, Grant. English Conversational Practice, New Delhi. Tata McGraw- Hill, 1975.

CHY17R103	Environmental Science	L	T	P	C
		2	0	0	2

Course Outcome(s)	
CO1	To know the importance of environmental studies and methods of conservation of natural resources.
CO2	Describe the structure and function of an ecosystem and explain the values and Conservation of bio-diversity.
CO3	Explain the sources, environmental effects and control measures of various types of pollutions.
CO4	Select the appropriate methods for waste management.
CO5	Recall social issues and legal provision and describe the necessities for environmental act.

Unit-I: Natural Resources **6 Hrs**

Definition, scope, and importance of environmental sciences -Need for public awareness- Natural resources: Forest resources, Water resources, Land resources, Mineral resources, and Energy resources - Role of an individual in conservation of natural resources.

Unit-II: Ecosystem and Biodiversity **6 Hrs**

Concept of an ecosystem - Structure and function of an ecosystem - Food chains, food webs and ecological pyramids - Biodiversity - Definition, value of biodiversity- Hot spots of biodiversity - Threats to biodiversity - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-III: Environmental Pollution **6 Hrs**

Sources, consequences and control measures of Air pollution, Water pollution, Soil pollution, Thermal pollution and nuclear pollution. Environmental threats -, Acid rain, Climate change, Global warming (Greenhouse effect), Ozone layer depletion. Fireworks: current environmental issues.

Unit-IV: Management of Environmental Pollution **6 Hrs**

Causes, effects, treatments methods and control measures of solid waste, municipal waste, biomedical waste - Waste minimization techniques - Cleaner technology-- Disaster management: floods, earthquake, cyclone, landslides and Tsunami.

Unit-V: Social Issues and the Environment **6 Hrs**

Water conservation, rain water harvesting- Environmental impact assessment- Precautionary and polluters pay principle- environment protection act - air (prevention and control of pollution) act - water (prevention and control of pollution) act - Population explosion - Family Welfare Programmes - Environment and human health - Human Rights - Women and Child Welfare.

Text Books:

1. Dhameja, S. K., Environmental Engineering and Management, S. K. Kataria and sons, New Delhi, 1st Edition2015.
2. Anubha Kaushik and Kaushik C.P., Environmental Science & Engineering" New Age international Publishers, New Delhi, 2010.

References:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., 2nd edition, 2004.
2. Erach Bharucha, Textbook for Environmental Studies, UGC, New Delhi, 2004.
3. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co. USA, 2nd Edition2004.
4. Erach Bharucha, "The Biodiversity of India", Mapin publishing Pvt. Ltd., Ahmedabad India, 2002.
5. Trivedi R.K., "Handbook of Environmental Laws", Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro media, 2003.
6. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
7. Wager K.D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.
8. Sawyer C. N, McCarty P. L, and Parkin G. F., Chemistry for Environmental Engineering, McGraw-Hill, Inc., New York, 1994.

FRS19R121	Introduction to Forensic Science	L	T	P	C
		4	0	4	6

Course Outcomes:	After studying this course the students will know
CO1	The significance of forensic science to human society.
CO2	The fundamental principles and functions of forensic science.
CO3	Tools and techniques used in forensic science
CO4	Qualifications, duties and code of conduct of forensic scientists.
CO5	The divisions in a forensic science laboratory and the working of the forensic establishments in India and abroad.

Unit-I: History of Development of Forensic Science in India **12Hrs**

Functions of forensic science. Historical aspects of forensic science.

Unit-II: Principles of Forensic Science **12Hrs**

Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science. Frye case and Daubert standard.

Unit-III: Tools and Techniques in Forensic Science **12Hrs**

Branches of forensic science. Forensic science in international perspectives, including set up of INTERPOL and FBI.

Unit-IV: Duties, Code of Conduct and other Mandates of Forensic Scientists **12Hrs**

Duties of forensic scientists. Code of conduct for forensic scientists. Qualifications of forensic scientists. Data depiction. Report writing.

Unit-V: Organizational Set Up of Forensic Science Laboratories in India **12Hrs**

Hierarchical set up of Central Forensic Science Laboratories, State Forensic Science Laboratories, Government Examiners of Questioned Documents, Fingerprint Bureaus, National Crime Records Bureau, Police & Detective Training Schools, Bureau of Police Research & Development, Directorate of Forensic Science and Mobile Crime Laboratories. Police Academies. Police dogs. Services of crime laboratories. Basic services and optional services.

Experiments: **30 Hrs**

1. To study the history of crime cases from forensic science perspective.
2. To cite examples of crime cases in which apprehensions arose because of Daubert standards.
3. To review the sections of forensic science at INTERPOL and compare with those in Central Forensic Science Laboratories in India. Include suggestions for improvements if any.
4. To study the annual reports of National Crime Records Bureau and depict the data on different type of crime cases by way of smart art/templates.
5. To write report on different type of crime cases.
6. To review how the Central Fingerprint Bureau, New Delhi, coordinates the working of State Fingerprint Bureaus.

7. To examine the hierarchical set up of different forensic science establishments and suggest improvements.
8. To examine the list of projects undertaken by the Bureau of Police Research and Development and suggest the thrust areas of research in Police Science.
9. To compare and contrast the role of a Police Academy and a Police Training School.
10. To compare the code of conduct prescribed by different establishments for forensic scientists.

Text Books:

1. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
2. W.J. Tilstone, M.L. Hastrup and C. Hald, *Fisher's Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

References:

1. B.B. Nanda and R.K. Tiwari, *Forensic Science in India: A Vision for the Twenty First Century*, Select Publishers, New Delhi (2001).
2. M.K. Bhasin and S. Nath, *Role of Forensic Science in the New Millennium*, University of Delhi, Delhi (2002).
3. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
4. W.G. Eckert and R.K. Wright in *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).

FRS19R122	Criminalistics	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to understand:	
CO1	The methods of securing, searching and documenting crime scenes.
CO2	The art of collecting, packaging and preserving different types of physical and trace evidence at crime scenes.
CO3	The legal importance of chain of custody.
CO4	The tools and techniques for analysis of glass and paint as crime scene evidence.
CO5	The tools and techniques for analysis of fibre, soil and tool marks as crime scene evidence.

Unit-I: Crime Scene Management **12 Hrs**

Types of crime scenes – indoor and outdoor. Securing and isolating the crime scene. Crime scene search methods. Safety measures at crime scenes. Legal considerations at crime scenes. Documentation of crime scenes – photography, videography, sketching and recording notes.

Unit-II: Preliminary Procedures related to Crime Scene Management **12 Hrs**

Duties of first responders at crime scenes. Coordination between police personnel and forensic scientists at crime scenes. The evaluation of 5Ws (who?, what?, when?, where?, why?) and 1H (how?). Crime scene logs.

Unit-III: Crime Scene Evidence **12 Hrs**

Classification of crime scene evidence – physical and trace evidence. Locard principle. Collection, labeling, sealing of evidence. Hazardous evidence. Preservation of evidence. Chain of custody. Reconstruction of crime scene.

Unit-IV: Forensic Physics about Glass and Paint **12 Hrs**

Glass evidence – collection, packaging, analysis. Matching of glass samples by mechanical fit and refractive index measurements. Analysis by spectroscopic methods. Fracture analysis and direction of impact.

Paint evidence – collection, packaging and preservation. Analysis by destructive and nondestructive methods. Importance of paint evidence in hit and run cases.

Unit-V: Forensic Physics about Fibre, Soil and Tool Marks **12 Hrs**

Fibre evidence – artificial and man-made fibres. Collection of fibre evidence. Identification and comparison of fibres.

Soil evidence – importance, location, collection and comparison of soil samples. Cloth evidence – importance, collection, analysis of adhering material. Matching of pieces.

Tool mark evidence. Classification of toolmarks. Forensic importance of tool marks. Collection, preservation and matching of toolmarks. Restoration of erased serial numbers and engraved marks.Forensic gemmology.

Experiments **30 Hrs**

1. To prepare a report on evaluation of crime scene.
2. To reconstruct a crime scene (outdoor and indoor).
3. To compare soil samples by density gradient method.
4. To compare paint samples by physical matching method.
5. To compare paint samples by thin layer chromatography method.
6. To compare glass samples by refractive index method.
7. To identify and compare tool marks.
8. To compare cloth samples by physical matching.

Text Books:

1. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).
2. S.H. James and J.J. Nord by, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).

References:

1. M. Byrd, *Crime Scene Evidence: A Guide to the Recovery and Collection of Physical Evidence*, CRC Press, Boca Raton (2001).
2. T.J. Gardener and T.M. Anderson, *Criminal Evidence*, 4th Ed., Wadsworth, Belmont (2001).

SEMESTER II

BAE17R112	தமிழ் இலக்கிய வரலாறும் புதினமும்	L	T	P	C
		3	0	0	3

கூறு-I: **9 Hrs**

தமிழ் மொழியின் பழமையும் சிறப்பும் –திராவிட மொழிக்குடும்பம்

தமிழ்நாடு-தமிழின் சிறப்புகள்

பழந்தமிழ் இலக்கண நூல்கள்-தொல்காப்பியம்,நன்னூல் முதலிய இலக்கண நூல்கள்-எழுத்து,சொல்,பொருள் அதிகாரங்கள்

கூறு-II: **9 Hrs**

சங்க காலம்-மூன்று சங்கங்கள்-இலக்கியச் சான்றுகள்-கல்வெட்டுச் சான்றுகள்

இலக்கண,சங்க நூல்களின் சிறப்பு-பத்துப் பாட்டு-எட்டுத்தொகை-சங்கத் தமிழர் மாண்புகள்

கூறு-III: **9 Hrs**

சங்கம் மருவிய காலம்-பதிணெண் கீழ்க்கணக்கு நூல்கள்-வகைகள்

காப்பிய இலக்கிய வரலாறு-ஐம்பெருங்காப்பயங்கள்-சிறு காப்பியங்கள்-காப்பியக்கூறுகள்

கூறு-IV: **9 Hrs**

புதினம்

தேடல்

கூறு-V: **9 Hrs**

அடிப்படை இலக்கணம்

முதல்,சார்பு எழுத்துக்கள்,மொழி முதல்,இறுதி எழுத்துக்கள்,வல்லினம் மிகும் மிகா இடங்கள்

பாட நூல்:

1. தமிழ் இலக்கிய வரலாறு

   முனைவர் ச.வே.சுப்பிரமணியன்

   மணிவாசகர் பதிப்பகம்

   31,சிங்கர் தெரு,பாரி முனை,

   சென்னை-600 108

2. நன்னூல்-எழுத்ததிகாரம்
முனைவர் சு.அழகேசன் உரை
சுதன் பதிப்பகம்
தூத்துக்குடி
3. தேடல்
பொன்னீலன்
ஒன்பதாம் பதிப்பு
நியூபுக் ஹவுஸ் வெளியீடு
சென்னை-98

XXXX17R001	Hindi - Basics	L	T	P	C
		3	0	0	3

Unit – I

Utsaaha	Ramachandra shukla
Charitra ka sanghathan	Babu gulaaba rai
Bajaaara darshan	Jainendra Kumar
sadgati	Premchand (katha sindhu)

Unit - II

Bhaabhi	Mahaadevivarma
Bharat mein sanskriti sangam	Ramdharisimha Dinakar
Rashtra ka swaroop	Vasudeva sharan Agarval
Chota jadugar	Jai Shankar Prasa (Katha Sindhu)

Unit - III

Sach ka sauda	Sudarshan (Katha Sindhu)
Praaya chitt	Bhagavati charan varma (Katha Sindhu)
Pardaa	Yashpal (Katha Sindhu)
Chief ki daavat	Bheeshma sahaani (Katha sindhu)

Unit - IV

Rewriting of sentences as directed based on Gender, Number, Tense, Case and Voice.
Correction of sentences.
Usages of words into sentences.

Unit - V

Official Hindi:
Administrative Terminiology (Prashaasanika shabdavali)
Official designations (Padanaam)
Translation of Hindi words into English words
Translation of English words into Hindi words

BAE17R107	Communicative English	L	T	P	C
		2	0	0	2

Course Outcome(s)	
CO1	Understand the types of communication
CO2	Analyse the verbal communication and non verbal communication
CO3	Practice dynamics of professional presentations
CO4	Know how to translate the foreign language
CO5	Know how to write letters both personal and professional

Unit-I: Introduction: **6 Hrs**

Theory of Communication - Types and modes of Communication

Unit-II: Language of Communication: **6 Hrs**

Verbal and Non-verbal (Spoken and Written)-Personal, Social and Business - Barriers and Strategies-Intra Personal, Inter Personal and Group Communication

Unit-III: Speaking Skills: **6 Hrs**

Monologue - Dialogue - Group Discussion-Effective Communication/Mis-Communication - Interview - Public Speech

Unit-IV: Reading and Understanding: **6 Hrs**

CloZe Reading - Comprehension - Summary Paraphrasing - Analysis and Interpretation - Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit-V: Writing Skills: **6 Hrs**

Documenting - Report Writing - Making notes - Letter Writing

Text Books:

1. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brat Biswas
2. Fluency in English Part II Oxford University Press, 2006
3. Business English, Pearson, 2008.

FRS19R123	Criminal Law	L	T	P	C
		4	0	4	6

Course Outcomes:	After studying this course the students will be acquainted with
CO1	Elements of criminal procedure.
CO2	Codes related to forensic science
CO3	Acts and provisions of the Constitution of India related to forensic science.
CO4	Acts governing socio-economic crimes.
CO5	Acts governing environmental crimes.

Unit-I: Law to Combat Crime **12Hrs**

Classification – civil, criminal cases. Essential elements of criminal law. Constitution and hierarchy of criminal courts. Criminal Procedure Code. Cognizable and non-cognizable offences. Bailable and non-bailable offences. Sentences which the court of Chief Judicial Magistrate may pass. Summary trials – Section 260(2). Judgements in abridged forms – Section 355.

Unit-II: Criminal Codes **12Hrs**

Indian Penal Code pertaining to offences against persons – Sections 121A, 299, 300, 302, 304A, 304B, 307, 309, 319, 320, 324, 326, 351, 354, 359, 362. Sections 375 & 377 and their amendments. Indian Penal Code pertaining to offences against property Sections – 378, 383, 390, 391, 405, 415, 420, 441, 463, 489A, 497, 499, 503, 511. Indian Evidence Act – Evidence and rules of relevancy in brief. Expert witness. Cross examination and re-examination of witnesses. Sections 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, 138, 141. Section 293 in the code of criminal procedure.

Unit-III: Constitution of India **12Hrs**

Preamble, Fundamental Rights, Directive Principles of State Policy. – Articles 14, 15, 20, 21, 22, 51A.

Unit-IV: Acts Related to Socio-Economic Crimes **12Hrs**

Narcotic, Drugs and Psychotropic Substances Act. Essential Commodity Act. Drugs and Cosmetics Act. Explosive Substances Act. Arms Act. Dowry Prohibition Act. Prevention of Food Adulteration Act. Prevention of Corruption Act.

Unit-V: Acts Related to Environmental Crimes **12Hrs**

Wildlife Protection Act. I.T. Act. Environment Protection Act. Untouchability Offences Act

Experiments: **30 Hrs**

1. To prepare a schedule of five cognizable and five non-cognizable offences.
2. To study the powers and limitations of the Court of Judicial Magistrate of First Class.
3. To prepare a schedule of the offences which may be tried under Section 260(2) of Criminal Procedure Code.

4. To study a crime case in which an accused was punished on charge of murder under Section 302.
5. To study a crime case in which an accused was punished on charge of rape under Section 375.
6. To cite example of a case in which the opinion of an expert was called for under Section 45 of the Indian Evidence Act.
7. To cite a case wherein a person was detained under Article 22(5) of the Indian Constitution. Express your views whether the rights of the person as enlisted in this Article were taken care of.
8. To cite a case under Article 14 of the Constitution of India wherein the Right to Equality before Law was allegedly violated.
9. To list the restrictions imposed on Right to Freedom of Worship under the Constitution of India.
10. To prepare a schedule of persons convicted under Narcotics, Drugs and Psychotropic Act statistically analyze the age group to which they belonged.
11. To study a case in which Drugs and Cosmetic Act was invoked.
12. To study a case in which Explosive Substances Act was invoked.
13. To study a case in which Arms Act was invoked.
14. In light of Section 304B of the Indian Penal Code, cite a case involving dowry death.
15. To study a case wherein the Untouchability Offences Act was invoked on the basis of Article 15 of the Constitution of India.

Text Books:

1. Vipa P. Sarthi, *Law of Evidence*, 6th Edition, Eastern Book Co., Lucknow (2006).
2. A.S. Pillia, *Criminal Law*, 6th Edition, N.M. Tripathi Pvt Ltd., Mumbai (1983).

References:

1. D.A. Bronstein, *Law for the Expert Witness*, CRC Press, Boca Raton (1999).
2. R.C. Nigam, *Law of Crimes in India*, Volume I, Asia Publishing House, New Delhi (1965).
3. (Chief Justice) M. Monir, *Law of Evidence*, 6th Edition, Universal Law Publishing Co. Pvt. Ltd., New Delhi (2002).

FRS19R124	Technological Methods in Forensic Science	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to realize:	
CO1	The importance of chromatographic techniques in processing crime scene evidence.
CO2	The importance of spectroscopic techniques in processing crime scene evidence.
CO3	The utility of X-rays, electrophoresis and neutron activation analysis in identifying chemical and biological materials.
CO4	The significance of microscopy in visualizing trace evidence and comparing it with control samples.
CO5	The usefulness of photography and videography for recording the crime scenes.

Unit-I: Chromatographic Techniques **12 Hrs**

Sample preparation for chromatographic and spectroscopic evidence. Chromatographic methods. Fundamental principles and forensic applications of thin layer chromatography, gas chromatography and liquid chromatography.

Unit-II: Spectroscopic Techniques **12 Hrs**

Spectroscopic methods. Fundamental principles and forensic applications of Ultraviolet-visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy, atomic emission spectroscopy and mass spectroscopy. Colorimetric analysis and Lambert-Beer law.

Unit-III: Electro and Radio Analytical Techniques **12 Hrs**

X-ray spectrometry. Electrophoresis – fundamental principles and forensic applications. Neutron activation analysis – fundamental principles and forensic applications.

Unit-IV: Microscopy **12 Hrs**

Fundamental principles. Different types of microscopes. Electron microscope. Comparison Microscope. Forensic applications of microscopy.

Unit-V: Forensic photography **12 Hrs**

Basic principles and applications of photography in forensic science. 3D photography. Photographic evidence. Infrared and ultraviolet photography. Digital photography. Videography. Crime scene and laboratory photography.

Experiments: **30 Hrs**

1. To determine the concentration of a colored compound by colorimetry analysis.
2. To carry out thin layer chromatography of ink samples.
3. To carry out separation of organic compounds by paper chromatography.
4. To identify drug samples using UV-Visible spectroscopy.
5. To take photographs using different filters.
6. To take photographs of crime scene exhibits at different angles.
7. To record videography of a crime scene.

Text Books:

D.R. Redsicker, *The Practical Methodology of Forensic Photography*, 2nd Edition, CRC Press, Boca Raton (2000).

References:s

1. D.A. Skoog, D.M. West and F.J. Holler, *Fundamentals of Analytical Chemistry*, 6th Edition, Saunders College Publishing, Fort Worth (1992).
2. W. Kemp, *Organic Spectroscopy*, 3rd Edition, Macmillan, Hampshire (1991).
3. J.W. Robinson, *Undergraduate Instrumental Analysis*, 5th Edition, Marcel Dekker, Inc., New York (1995).

SECOND YEAR

SEMESTER III

FRS19R221	Forensic Serology	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to know:	
CO1	The importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.
CO2	The various aspects of semen analysis
CO3	The significance of bodily fluids other than blood and semen.
CO4	The usefulness of genetic markers in forensic investigations.
CO5	The forensic importance of bloodstain patterns

Unit-I: Forensic Importance of Body fluids **12 Hrs**

Common body fluids. Composition and functions of blood. Collection and preservation of blood evidence. Distinction between human and non-human blood. Determination of blood groups. Antigens and antibodies. Forensic characterization of bloodstains. Typing of dried stains. Blood enzymes and proteins.

Unit-II: Various Aspects of Semen Analysis **12 Hrs**

Semen. Forensic significance of semen. Composition, functions and morphology of spermatozoa. Collection, evaluation and tests for identification of semen. Individualization on the basis of semen examination.

Unit-III: Analysis of Other Bodily Fluids **12 Hrs**

Composition, functions and forensic significance of saliva, sweat, milk and urine. Tests for their identifications.

Unit-IV: Genetic Marker Analysis **12 Hrs**

Cellular antigens. ABO blood groups. Extracellular proteins and intracellular enzymes. Significance of genetic marker typing data. Sexual assault investigations.

Unit-V: Bloodstain Pattern Analysis **12 Hrs**

Bloodstain characteristics. Impact bloodstain patterns. Cast-off bloodstain patterns. Projected bloodstain patterns. Contact bloodstain patterns. Blood trails. Bloodstain drying times. Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis.

Experiments: **30 Hrs**

1. To determine blood group from fresh blood samples.
2. To determine blood group from dried blood sample.

3. To carry out the crystal test on a blood sample.
4. To identify blood samples by chemical tests.
5. To identify the given stain as saliva.
6. To identify the given stain as urine.
7. To carry out cross-over electrophoresis.
8. To study the correlation between impact angle and shape of bloodstain.
9. To identify the point of convergence from the bloodstain patterns.

Text Books:

1. T. Bevel and R.M. Gardner, *Bloodstain Pattern Analysis*, 3rd Edition, CRC Press, Boca Raton (2008).
2. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).

References:

1. W.G. Eckert and S.H. James, *Interpretation of Bloodstain Evidence at Crime Scenes*, CRC Press, Boca Raton (1989).
2. G.T. Duncan and M.I. Tracey in *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).

FRS19R222	Forensic Dermatoglyphics	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to understand:	
CO1	The fundamental principles on which the science of fingerprinting is based.
CO2	The method of classifying criminal record by fingerprints.
CO3	The physical and chemical techniques of developing fingerprints on crime scene evidence.
CO4	The various methods of preserving fingerprints.
CO5	The significance of foot, palm, ear and lip prints.

Unit-I: Basics of Fingerprinting **12 Hrs**

Introduction and history, with special reference to India. Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns. Fingerprint characters/minutiae. Plain and rolled fingerprints.

Unit-II: Classification and Documentation of Fingerprints **12 Hrs**

Classification and cataloguing of fingerprint record. Automated Fingerprint Identification System. Significance of poroscopy and edgeoscopy.

Unit-III: Development of Fingerprints **12 Hrs**

Latent prints. Constituents of sweat residue. Latent fingerprints' detection by physical and chemical techniques. Mechanism of detection of fingerprints by different developing reagents. Application of light sources in fingerprint detection.

Unit-IV: Preservation of Fingerprints **12 Hrs**

Preservation of developed fingerprints. Digital imaging for fingerprint enhancement. Fingerprinting the deceased. Developing fingerprints on gloves.

Unit-V: Other Impressions **12 Hrs**

Importance of footprints. Casting of foot prints, Electrostatic lifting of latent foot prints. Palm prints. Lip prints - Nature, location, collection and examination of lip prints. Ear prints and their significance. Palm prints and their historical importance.

Experiments: **30 Hrs**

1. To record plain and rolled fingerprints.
2. To carry out ten digit classification of fingerprints.
3. To identify different fingerprint patterns.
4. To identify core and delta.
5. To carry out ridge tracing and ridge counting.
6. To investigate physical methods of fingerprint detection.
7. To investigate chemical methods of fingerprint detection.
8. To use different light sources for enhancing developed fingerprints.
9. To prepare cast of foot prints.

Text Books:

1. Lee and Gaensleen's, *Advances in Fingerprint Technology*, 3rd Edition, R.S. Ramotowski (Ed.), CRC Press, Boca Raton (2013).
2. C. Champod, C. Lennard, P. Margot an M. Stoilovic, *Fingerprints and other Ridge Skin Impressions*, CRC Press, Boca Raton (2004).

References:

1. J.E. Cowger, *Friction Ridge Skin*, CRC Press, Boca Raton (1983).
2. D.A. Ashbaugh, *Quantitative-Qualitative Friction Ridge Analysis*, CRC Press, Boca Raton (2000).

SEMESTER IV

FRS19R223	Forensic Chemistry	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to realize:	
CO1	The methods of analyzing trace amounts of petroleum products in crime scene evidence.
CO2	The method of searching, collecting, preserving and analyzing arson evidence.
CO3	The process of post-fire analysis of materials.
CO4	The classification of explosives, including the synthesis and characterization of representative analogs.
CO5	The techniques of locating hidden explosives and the significance of bomb scene management.

Unit-I: Petroleum and Petroleum Products **12 Hrs**

Distillation and fractionation of petroleum. Commercial uses of different petroleum fractions. Analysis of petroleum products. Analysis of traces of petroleum products in forensic exhibits. Comparison of petroleum products. Adulteration of petroleum products.

Unit-II: Cases Involving Arson **12 Hrs**

Chemistry of fire. Conditions for fire. Fire scene patterns. Location of point of ignition. Recognition of type of fire. Searching the fire scene. Collection and preservation of arson evidence.

Unit-III: Post-fire Analysis of Materials **12 Hrs**

Analysis of fire debris. Analysis of ignitable liquid residue. Post-flashover burning. Scientific investigation and evaluation of clue materials. Information from smoke staining.

Unit-IV: Explosives **12 Hrs**

Classification of explosives – low explosives and high explosives. Homemade explosives. Military explosives. Blasting agents. Synthesis and characteristics of TNT, PETN and RDX.

Unit-V: Explosion Process and Detection **12 Hrs**

Explosion process. Blast waves. Bomb scene management. Searching the scene of explosion. Mechanism of explosion. Post blast residue collection and analysis. Blast injuries. Detection of hidden explosives.

Experiments: **30 Hrs**

1. To carry out analysis of gasoline.
2. To carry out analysis of diesel.
3. To carry out analysis of kerosene oil.
4. To analyze arson accelerators.

5. To prepare a case report on a case involving arson.
6. To carry out analysis of explosive substances.
7. To separate explosive substances using thin layer chromatography.
8. To prepare a case report on bomb scene management.

Text Books:

1. S. Ballou, M. Houck, J.A. Siegel, C.A. Crouse, J.J. Lentini and S. Palenik in *Forensic Science*, D.H. Ubelaker (Ed.), Wiley-Blackwell, Chichester (2013).
2. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

References:

1. J.D. DeHaan, *Kirk's Fire Investigation*, 3rd Edition, Prentice Hall, New Jersey (1991).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, The Foundation Press, Inc., New York (1995).
3. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).

FRS19R224	Forensic Biology	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to know:	
CO1	The role of biological evidence in forensics.
CO2	The forensic importance of hair evidence.
CO3	The importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.
CO4	How wildlife forensics aid in conserving natural resources.
CO5	How forensic entomology assists in death investigations.

Unit-I: Biological Evidence **12 Hrs**

Nature and importance of biological evidence. Significance of hair evidence. Transfer, persistence and recovery of hair evidence.

Unit-II: Hair as Evidence **12 Hrs**

Structure of human hair. Comparison of hair samples. Morphology and biochemistry of human hair. Comparison of human and animal hair.

Unit-III: Microorganisms and Botanical Evidences in Forensics **12 Hrs**

Types and identification of microbial organisms of forensic significance. Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance.

Unit-IV: Wildlife Forensics **12 Hrs**

Fundamentals of wildlife forensics. Significance of wildlife forensics. Protected and endangered species of animals and plants. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals.

Unit-V: Forensic Entomology **12 Hrs**

Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations.

Experiments: **30 Hrs**

To examine hair morphology and determine the species to which the hair belongs.

1. To prepare slides of scale pattern of human hair.
2. To examine human hair for cortex and medulla.
3. To carry out microscopic examination of pollen grains.
4. To carry out microscopic examination of diatoms.
5. To cite a crime case in which diatoms have served as forensic evidence.
6. To prepare a case report on forensic entomology.
7. To prepare a case report on problems of wildlife forensics.

Text Books:

G.T. Duncan and M.I. Tracey, Serology and DNA typing in, *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).

References:

1. L. Stryer, *Biochemistry*, 3rd Edition, W.H. Freeman and Company, New York (1988).
2. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, *Harper's Biochemistry*, APPLETON & Lange, Norwalk (1993).
3. S. Chowdhuri, *Forensic Biology*, BPRD, New Delhi (1971).
4. R. Saferstein, *Forensic Science Handbook*, Vol. III, Prentice Hall, New Jersey (1993).

FRS19R299	Training /Internship	L	T	P	C
		0	0	0	4

The students will be expected to undergo training/internship in forensic laboratories to get hands-on experience in the field of investigating a crime scene and to develop the analytical skills required for a forensic scientist. The report about the training/internship will be based on the work undertaken in Forensic Science Laboratory and the same will be evaluated. The training/internship should be undertaken during the summer vacation of the second year.

THIRD YEAR

SEMESTER V

FRS19R321	Forensic Ballistics	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to understand:	
CO1	The classification of firearms and their firing mechanisms.
CO2	The methods of identifying firearms.
CO3	The characteristics of ammunition.
CO4	The importance of firearm evidence.
CO5	The methods for characterization of gunshot residues and the nature of firearm injuries.

Unit-I: Firearms **12 Hrs**

History and development of firearms. Classification of firearms. Weapon types and their operation. Firing mechanisms of different firearms. Internal ballistics – Definition, ignition of propellants, shape and size of propellants, manner of burning, and various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting.

Unit-II: External Ballistics of Firearms **12 Hrs**

External Ballistics – Vacuum trajectory, effect of air resistance on trajectory, base drag, drop, drift, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistic data. Terminal Ballistics – Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, tumbling of bullets, effect of instability of bullet, effect of intermediate targets, influence of range. Ricochet and its effects, stopping power.

Unit-III: Ammunition **12 Hrs**

Types of ammunition. Constructional features and characteristics of different types of cartridges and bullets. Primers and priming compounds. Projectiles. Headstamp markings on ammunitions. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks.

Unit-IV: Firearm Evidence **12 Hrs**

Matching of bullets and cartridge cases in regular firearms. Identification of bullets, pellets and wads fired from improvised, country made firearms. Automated method of bullet and cartridge case comparison. Determination of range of fire and time of fire. Mechanisms of formation of gunshot residues.

Unit-V: Characterization of Gunshot Residues **12 Hrs**

Methods of analysis of gunshot residues from shooting hands and targets, with special reference to clothings. Identification and nature of firearms injuries. Reconstruction with respect to accident, suicide, murder and self defence.

Experiments: **30 Hrs**

1. To describe, with the aid of diagrams, the firing mechanisms of different types of firearms.
2. To correlate the velocity of bullet with the impact it produces on the target.
3. To correlate the striking angle of the bullet with the impact on the target.
4. To estimate the range of fired bullets.
5. To carry out the comparison of fired bullets.
6. To carry out the comparison of fired cartridge cases.
7. To identify gunshot residue.
8. To correlate the nature of injuries with distance from which the bullet was fired.
9. To differentiate, with the aid of diagram, contact wounds, close range wounds and distant wounds.

Text Books:

1. A.J. Schwoeble and D.L. Exline, *Current Methods in Forensic Gunshot Residue Analysis*, CRC Press, Boca Raton (2000).
2. E. Elaad in *Encyclopedia of Forensic Science, Volume 2*, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).

References:

1. B.J. Heard, *Handbook of Firearms and Ballistics*, Wiley and Sons, Chichester (1997).
2. W.F. Rowe, Firearms identification, *Forensic Science Handbook*, Vol. 2, R. Saferstein (Ed.), Prentice Hall, New Jersey (1988).

SEMESTER VI

FRS19R322	Forensic Toxicology	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to realize:	
CO1	The significance of toxicological studies in forensic science
CO2	The classification of poisons and their modes of actions.
CO3	The absorption of poisons in body fluids and the forensic identification of illicit liquors.
CO4	The classification and characteristics of the narcotics, drugs and psychotropic substances.
CO5	The methods of identifying and purifying narcotics, drugs and psychotropic substances.

Unit-I: Basics of Toxicology **12 Hrs**

Significance of toxicological findings. Techniques used in toxicology. Toxicological analysis and chemical intoxication tests. Postmortem Toxicology. Human performance toxicology. Dose-response relationship. Lethal dose 50 and effective dose 50.

Unit-II: Poisons **12 Hrs**

Classification of poisons. Physico-chemical characteristics and mode of action of poisons. Accidental, suicidal and homicidal poisonings. Signs and symptoms of common poisoning and their antidotes. Collection and preservation of viscera, blood and urine for various poison cases. Identification of biocides and metal salts in body fluids. Metabolism and excretion of poisons.

Unit-III: Identification of Toxins **12 Hrs**

Application of immunoassays in forensic work. Animal poisons. Snake venom. Mode of action. Carbon monoxide poisoning. Vegetable poisons. Poisonous seeds, fruits, roots and mushrooms. Beverages. Alcoholic and non-alcoholic illicit liquors. Analysis and identification of ethyl alcohol. Estimation of ethyl alcohol in blood and urine. Proof spirit. Crime scene management in illicit liquor cases.

Unit-IV: Narcotics, Drugs and Psychotropic Substances **12 Hrs**

Definition of narcotics, drugs and psychotropic substances. Broad classification – Narcotics, stimulants, depressants and hallucinogens. General characteristics and common example of each classification. Natural, synthetic and semi-synthetic narcotics, drugs and psychotropic substances. Designer drugs. Tolerance, addiction and withdrawal symptoms of narcotics, drugs and psychotropic substances Crime scene search for narcotics, drugs and psychotropic substances – searching a suspect, searching a dwelling, searching a vehicle. Clandestine drug laboratories. Collection and preservation of drug evidence.

Unit-V: Analysis of Narcotics **12 Hrs**

Testing of narcotics, drugs and psychotropic substances. Isolation techniques for purifying narcotics, drugs and psychotropic substances – thin layer chromatography, gas-liquid chromatography and high performance liquid chromatography. Presumptive and screening tests for narcotics, drugs and psychotropic substances. Microcrystalline testing of drugs of abuse. Analysis of narcotics, drugs and psychotropic substances in breast milk, saliva, urine, hair and antemortem blood. Drugs and driving. Dope tests. Analysis of narcotics, drugs and psychotropic substances in postmortem blood. Postmortem changes affecting the analysis of narcotics, drugs and psychotropic substances.

Experiments: **30 Hrs**

1. To identify biocides.
2. To identify metallic poisons.
3. To identify organic poisons.
4. To identify ethyl alcohol.
5. To identify methyl alcohol.
6. To carry out quantitative estimation of ethyl alcohol.
7. To prepare iodoform.
8. To identify drugs of abuse by spot tests.
9. To perform color tests for barbiturates.
10. To separate drugs of abuse by thin layer chromatography.

Text Books:

W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

References:

1. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
2. F.G. Hofmann, *A Handbook on Drug and Alcohol Abuse*, 2nd Edition, Oxford University Press, New York (1983).
3. S.B. Karch, *The Pathology of Drug Abuse*, CRC Press, Boca Raton (1996).
4. A. Poklis, Forensic toxicology in, *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
5. A.W. Jones, Enforcement of drink-driving laws by use of per se legal alcohol limits: Blood and/or breath concentration as evidence of impairment, *Alcohol, Drug and Driving*, 4, 99 (1988).

GENERIC ELECTIVES

FRS19RG01	Physics	L	T	P	C
		4	0	4	6

Course Outcome(s) Upon successful completion of this course, students will be able to	
CO1	Understand the concepts of crystallography
CO2	Apply the concepts of optics in laser and fiber optics.
CO3	Explore the knowledge on Ultrasonics and energy physics
CO4	Understand the advanced materials
CO5	Apply the knowledge on instrumentation techniques

Unit-I: Crystal Physics **12 Hrs**

Crystalline and amorphous solids – lattice and unit cell – seven crystal system and Bravais lattices- Miller indices – d-spacing in cubic lattice - Calculation of number of atoms per unit cell – Atomic radius – Coordination number - Packing factor for SC, BCC, FCC and HCP structures - Crystal preparation by slow evaporation and Czochralski method -Bragg's law for X-ray diffraction – Laue method – Powder method.

Unit-II: Laser and Fiber Optics **12 Hrs**

instein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne), solid-state lasers (Neodymium), applications of lasers in science, engineering and medicine. Numerical aperture and Acceptance angle of fibre – Types of optical fibre - Active and passive fibre sensors- Endoscope.

Unit-III: Ultrasonics and Energy Physics **12 Hrs**

Production of ultrasonics by magnetostriction and piezo electric methods - Acoustical grating - SONAR – pulse echo system through transmission and reflection modes – A, B and C scan display – Medical applications. Introduction to non-conventional energy sources – Solar cells – Thermoelectric power generators — Fuel cell -PEM Fuel cell – Solid state batteries (Lithium) – Biomass energy sources.

Unit-IV: Advanced Materials **12 Hrs**

Metallic glasses – Preparation, properties and applications - Shape memory alloys – characteristics, properties and applications; Nanomaterials - introduction and properties– synthesis- Biomaterials and applications- Radioactive materials: properties, medical applications

Unit-V: Instrumentation **12 Hrs**

Atomic force microscopy – Instrumentation and result analysis. Scanning electron microscopy - Thermal Analytical Techniques: Principles, methodology and use of differential thermal analysis Thermo gravimetric analysis, Ultrasonic scanning methods, UV - Vis Spectroscopy.

List of Experiments **30 Hrs**

1. To determine the dispersive power of prism using spectrometer and mercury source
2. To determine the wavelength of sodium light by Newton's Ring
3. To determine the wavelength of sodium light using diffraction grating
4. To determine the numeral aperture (NA) of a Optical Fibre.
5. To find the wavelength of He-Ne Laser using transmission diffraction grating.
6. To determine the refractive index of a prism using spectrometer.
7. To determine the thickness of a material using air wedge method
9. To determine the velocity and compressibility of ultrasonic waves using Ultrasonic interferometer.
10. To estimate the band gap energy using given UV spectrum
11. To calculate the atomic number, thickness of the particle, cell constants using given XRD pattern.

Text Books:

1. Ghatak, "Optics" Fifth edition, Tata McGraw-Hill Inc, 2012.
2. N. Subrahmanyam and Brij Lal, "A Text Book of Optics", S. Chand Limited, 2015.
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009.
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011

References:

1. Kailash K. Sharma Optics: Principles and Applications Elsevier, 2006
2. William T. Silfvast, Laser Fundamentals, Cambridge University Press, New York, 2nd Edition, 2004
3. Gaur R. K, and Gupta S. L, Engineering Physics, Dhanpat Rai & Sons, New Delhi, 7th Edition, 1993
3. Halliday D, Resnick R and Waler J, Fundamentals of Physics, Wiley and Sons, New York, 6th Edition, 2001
4. Rajput B.S, Pragati Prakashan, Advanced Quantum Mechanics, Pragati publications, New Market, Begum Bridge, Meerut, 2009.
5. Practical Physics – S.L. Gupta & V. Kumar (Pragati Prakashan).
6. Advanced Practical Physics – B.L. Workshop and H.T. Flint (KPH)
7. Advanced Practical Physics Vol. I & II – Chauhan & Singh (Pragati Prakashan)
8. Physics Laboratory Manual, prepared by Department of Physics, Kalasalingam University.

CHY19R143	Chemistry	L	T	P	C
		4	0	4	6

Course Outcome(s): Upon successful completion of this course, students will be able to	
CO1	To understand the atomic and molecular structure.
CO2	To know the basic concepts in the periodicity of elements.
CO3	Apply the concepts of thermodynamic functions and corrosion and its preventive measures.
CO4	To understand the principles involved in the organic reactions.
CO5	Analyse the fundamentals of stereochemistry and the applications of spectroscopic techniques.

Unit -I: Atomic and Molecular Structure **12 Hrs**

Schrodinger wave equation: Derivation of time independent Schrodinger wave equation, Representation of Schrodinger wave equation in polar coordinates - Radial distribution function graphs of s, p, d and f orbitals. Molecular Orbital Theory: MOT concept, MO diagrams of homo-nuclear diatomic molecules (hydrogen, nitrogen and oxygen) and hetero-nuclear diatomic molecules (carbon monoxide and nitric oxide). Crystal field theory: CFT concept, weak and strong ligands, energy level diagrams of transition metal ions (Fe^{2+}& Fe^{3+}) in octahedral and tetrahedral complexes and their magnetic properties. Intermolecular forces - Ionic, dipolar and van der Waals interactions.

Unit-II: Periodic Properties **12 Hrs**

Effective nuclear charge - Factors affecting effective nuclear charge: Penetration or shielding of orbitals - Variation of s, p, d and f orbital energies of atoms in the periodic table - Aufbau principle (Building-up principle)**:** Application of Aufbau principle in writing electronic configuration, Deviation from Aufbau principle - Periodicity of properties in a periodic table - Periodic properties: Atomic and ionic sizes, ionization energies, electron affinity and electronegativity - Variation of periodic properties in the periodic table - Hard soft acids and bases: Concept and examples.

Unit-III: Free Energy and Chemical Equilibria **12 Hrs**

Thermodynamic functions: Definition and mathematical expression for Work, Energy, Enthalpy, Entropy and Free energy - Nernst equation: Derivation, apply Nernst equation to determine of solubility product, pH (glass electrode). Potentiometric titrations: Acid-Base, Redox and precipitation reaction - Water analysis: Hardness by EDTA method and chloride ion by Argentomentric method - Corrosion: Definition, types (dry & wet) and mechanism. and control of Dry and Wet corrosion.

Unit-IV: Organic Reactions **12 Hrs**

Nucleophilic substitution reactions: Definition, types and examples of nucleophile, Compare nucleophilicity and basicity of a nuceophile - Types of nucleophilic substitution (case RX and ArX): Mechanism of S_N1, S_N2, S_Ni and Benzyne. Electrophilic substitution reactions: Definition, types and examples of electrophile - Electrophilic substitution reactions of hydrocarbons: Halogenation, sulphonation, nitration. Friedel crafts alkylation and acylation reaction. Nucleophilic addition reactions (case aldehydes and ketones): Polarity of C=O bond. General mechanism of nucleophilic addition reactions on aldehydes and ketones: HCN, HOH, ROH and $NaHSO_3$ addition. Electrophilic addition reactions (case alkenes): General mechanism of electrophilic addition reactions on alkene - Addition of HBr [Markownikoff & Anti-Markownikoff (peroxide effect)] - Addition of alkene (polymerization of ethylene). Elimination reactions: Types of elimination reactions (case alkyl halides): Dehydrohalogenation of alkyl halides - E_1 and E_2 mechanism - Dehydration of alcohols to alkene and ethers. Greener synthesis of drug molecules (Aspirin and Ibuprofen)

Unit-V: Stereochemistry & Spectroscopic Techniques **12 Hrs**

Stereochemistry - Definition with examples: Geometrical isomers (alkene) and stereoisomers, symmetry, chirality, enantiomers, diastereomers, meso and racemic mixture. Representation of 3D structures: Wedge formula, Fischer projections, Newmann and Sawhorse formula (upto 2 carbons) - Conformational analysis: Ethane, butane and cyclohexane - Configurational analysis: Rules of RS nomenclature and application of RS nomenclature to molecules containing one chiral centre. Electronic spectroscopy: Principle, instrumentation, selection rules and medicinal application of fluorescence spectroscopy. Nuclear magnetic resonance spectroscopy (^{1}H-NMR): Principle, instrumentation, chemical shift, coupling constant and application (structural identification of the compound C_3H_6O from ^{1}H-NMR data). X-ray diffraction: Principle, instrumentation and applications X-ray diffraction.

Experiments (Any 10): **30 Hrs**

1. Determination of Viscosity by Ostwald Viscometer.
2. Determination of surface tension by Stalagmometer.
3. Adsorption of acetic acid by charcoal.
4. Determination of chloride content of water.
5. Estimation of hardness of water by EDTA method.
6. Determination of the rate constant of a reaction (kinetics of acid hydrolysis of an ester)
7. Thin layer chromatography.
8. Determination of the partition coefficient of a substance between two immiscible liquids.
9. Determination of Saponification/acid value of oil.
10. Preparation of Aspirin
11. Determination of EMF of a cell.

12. Estimation of Ferrous ion by potentiometric titration.
13. Determination of cell constant of the conductivity cell.
14. Estimation of mixture of acids conductometrically.

Text Books:

1. Engineering Chemistry, 2nd Edition, Wiley India (P) Ltd., 2018.
2. Stereochemistry of Organic Compounds, Ernest L. Eliel, Samuel H. Wilen Student edition, Wiley India (P) Ltd., 2017.
3. University Chemistry, by B. M. Mahan and R.J.Mayers, Pearson Publishers, 11th Edition, Noida, 2017.
4. Chemistry Laboratory Manual, Department of Chemistry, Kalasalingam University, 2018.

References:

1. Fundamentals of Molecular Spectroscopy, by C. N. Banwell and E.M. McCash, Tata McGraw-Hill Publishers, 4th Edition, New Delhi, 2008.
2. Physical Chemistry, by P. W. Atkins and J.D. Paula, W H Freeman & Co Publishers, 10th Edition, 2014.
3. Modern Inorganic Chemistry, R. D. Madan, 4th Edition S. Chand & Company Ltd., 2009.
4. Organic Chemistry, Paula Y. Bruice, 7th Edition, Pearson (Dorling Kindersley India (P) Ltd.) 2014.
5. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma, M. S. Pathania, 47th Edition, Vishal Publishing Co., 2017.
6. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, 8th Edition, Wiley India (P) Ltd., 2010.
7. Inorganic Chemistry, Peter Atkins, Mark Weller, Fraser Armstrong, Jonathan Rourke, Tina Overton, Michael Hangerman 5th Edition, Oxford press, 2015.
8. Organic Chemistry, Volume 1, I. L. Finar, 6th Edition, Pearson (Thomson press India (P) Ltd.) 2014.

FRS19RG03	Computer Science	L	T	P	C
		4	0	4	6

Course Outcome(s): Upon successful completion of this course, students will be able to	
CO1	Understand the fundamentals of C programming.
CO2	Know the basic concepts of arrays and functions in C.
CO3	Apply the concepts of structures in C programming.
CO4	Understand the concept of pointers.
CO5	Analyse the fundamentals of input and output in prgramming.

Unit-I: Fundamentals of C Programming **12 Hrs**

History of C -Characteristics of C - C Program Structure - Data Types - Variables and Constants - Operators - Conditional Statements - Looping and Iteration.

Unit-II: Arrays and Functions in C **12 Hrs**

Single Dimensional Array -Multi Dimensional Array - Types of functions - Functions and Arrays - String Functions - Recursive Functions

Unit-III: Structures **12 Hrs**

Basics, Structures and functions - Arrays of structures - Pointers to structures - Self referential structures - Typedef - Union - Bitfields - Enum Data Types

Unit-IV: Pointers **12 Hrs**

Pointers : ntroduction - declaration - passing function to pointers - pointers with arrays - dynamic memory allocation.

Unit-V: Input and Output **12 Hrs**

File management and Console input and output – Functions for file management - Standard I/O, Formatted output - Formatted input - File access - Error handling.

Experiments: **30 Hrs**

1. To demonstrate use of data types, simple operators (expressions)
2. To demonstrate decision making statements (if and if-else, nested structures)
3. To demonstrate decision making statements (switch case)
4. To demonstrate use of simple loops
5. To demonstrate use of nested loops
6. To demonstrate menu driven programs and use of standard library functions.
7. To demonstrate writing C programs in modular way (use of user defined functions)

8. To demonstrate recursive functions.
9. To demonstrate use of arrays (1-d arrays) and functions
10. To demonstrate use of multidimensional array (2-d arrays) and functions
11. To demonstrate use of pointers
12. To demonstrate concept of strings (strings and pointers)
13. To demonstrate array of strings.
14. To demonstrate structures (using array and functions)
15. To demonstrate nested structures and Unions
16. To demonstrate file handling (text files)

Text Book:

E. Balagurusamy , Programming in Ansi C , 6th Edition, TMG - India 2012.

References:

1. Herbert Schildt, The Complete Reference C, 4th Edition, Tata Mc - Graw Hill, 2000.
2. Byron C Gottfried, Programming with C, Schaums' outline series 2nd Edition, Tata Mc - Graw Hill, 2006.

FRS19RG04	Economics	L	T	P	C
		4	0	0	6

Course Outcome(s) After completing this course, the student will be able to:	
CO1	Demonstrate the concept and types of economics and its application in managerial environment.
CO2	Understand the basic theories behind consumer behavior (demand) and producer behavior (supply) and identify the determinants of the demand and supply of goods.
CO3	Analyse the different costs in the product and study the long run and short run relationship of costs.
CO4	Understand the major characteristics of different market structures and the implications of the degrees of competition in a market on firms pricing and output decision.
CO5	Apply special pricing strategies for multi-product and transfer price.

Unit-I: Introduction to Managerial Economics **15Hrs**

Definition of Economics - Important concept of Economics – Basic Economic problem – Relationship between Micro and Macroeconomics – Managerial Economics – meaning, concept, significance and scope.

Unit-II: Basic of Demand and Supply **15 Hrs**

Demand Function, Supply function- Market Equilibrium Changes in market Equilibrium – Demand elasticity & Supply Elasticity – Effects of taxes, subsidies, price control, price support, Tariff and Quota Theory of consumer behavior, cardinal utility theory, ordinal utility theory (indifference curves, budget line, consumer choice, price effect, substitution effect, income effect for normal, inferior and giffen goods), revealed preference theory .

Unit-III: Theory of Production and Cost Analysis **15 Hrs**

Factors of Production, Production function -total product, average product and marginal product, Law of variable proportion, Returns to scale, Optimum factor combination. Different concepts of Cost & Revenue: short–run and long–run costs and revenues–economics, and diseconomies of scale.

Unit-IV: Market Structure and Pricing Decisions **15 Hrs**

Market Structure, degree of competition, pricing decisions, Features of perfect competition, monopoly, monopolistic competition and oligopoly. Perfect competition: Price and output decisions in the short run and the long run. Monopoly and Monopolistic Competition: Price and output decisions short run and long run equilibrium under monopoly and monopolistic competition- price discrimination by degree. Oligopoly: kinked demand curve- price leadership models –Collusion model: The Cartel.

Unit-V: Special Pricing Strategies **15 Hrs**

Cost-plus pricing, the multi-product pricing, Transfer Pricing, Peak-Load pricing, Product bundling.

Text Books:

1. Lipsey and Chrystal. Economics. 11th edition- Oxford University Press - New Delhi- (2008).
2. Dominick Salvatore. Principles of Microeconomics -5th Edition. Oxford University Press- New Delhi- (2009).

References:

2. Vanita Agarwal- Managerial Economics- Pearson Education- New Delhi. (2013).
3. Koutosyannis- Modern Micro Economics- Palgrave Macmillan- (1979).
4. Pindyck, Rubinfeld and Mehta. Micro Economics.

ABILITY ENHANCEMENT ELECTIVE COURSES (AEEC)

FRS19S01	Introduction to Biometry	L	T	P	C
		2	0	0	2

Course Outcome(s) After completing this course, the student will be able to realize:	
CO1	The basis of biometry.
CO2	Various features of biometric processes
CO3	Measurement of performance in biometric systems by different methods
CO4	The classification of biometric processes.
CO5	The importance of behavioral biometry.

Unit-I: Fundamental Aspects **6 Hrs**

Definition, characteristics and operation of biometric system. Classification of biometric systems – physiological and behavioral. Strength and weakness of physiological and behavioral biometrics.

Unit-II: Features of Biometric Processes **6 Hrs**

Multimodal biometrics. Key biometric processes – enrollment, identification and verification. Positive and negative identification.

Unit-III: Measurement of Performance in Biometric Systems **6 Hrs**

Performance measures used in biometric systems – FAR, FRR, GAR, FTA, FTE and ATV. Biometric versus traditional technologies.

Unit-IV: Physiological Biometrics **6 Hrs**

Fingerprints, palm prints, iris, retina, geometry of hand and face.

Unit-V: Behavioral Biometrics **6 Hrs**

Handwriting, signatures, keystrokes, gait and voice.

Text Books:

J.R. Vacca, *Biometric Technologies and Verification Systems,* Butterworth-Heinemann, Oxford (2007).

References:

1. S. Nanavati, M. Thieme and R. Nanavati, *Biometrics*, Wiley India Pvt. Ltd. (2002).
2. P. Reid, *Biometrics for Network Security*, New Delhi (2004).

FRS19S02	Handwriting Identification and Recognition	L	T	P	C
		2	0	0	2

Course Outcome(s) After completing this course, the student will be able to:	
CO1	Important features in handwriting identification.
CO2	Basis of handwriting characteristics.
CO3	Factors influencing handwriting
CO4	The examination of handwriting using different tools
CO5	The basis of handwriting recognition

Unit-I: Handwriting Identification **6 Hrs**

Basis of handwriting identification. Characteristics of handwriting – scope and application. Class and individual characteristics.

Unit-II: Qualitative Aspects of Handwriting **6 Hrs**

Arrangement, alignment, margin, slant, speed, pressure, spacing, line quality, embellishments, movement and pen lifts.

Unit-III: Factors Controlling Handwriting Pattern **6 Hrs**

Factors influencing handwriting – physical, mechanical, genetic and physiological.

Unit-IV: Handwriting Examination **6 Hrs**

Basis of handwriting comparison. Collection of handwriting samples. Forgery detection. Counterfeiting. Examination of altered and erased documents. Tools used in handwriting examination.

Unit-V: Handwriting Recognition **6 Hrs**

Basis of handwriting recognition. Off-line and on-line handwriting recognition. Steps involved in handwriting recognition – pre-processing, feature extraction and classification. Applications of handwriting recognition.

Text Books:

1. Z. Liu, J.H. Cai and R. Buse, Handwriting Recognition: *Soft Computing and Probabilistic Approach* (Volume 133), Springer Science and Business Media (2003).
2. R.N. Morris, *Forensic Handwriting Identification: Fundamental Concepts and Principles*, Academic Press, London (2000).

References:

1. O. Hilton, *Scientific Examination of Questioned Documents*, CRC Press, Boca Raton (1982).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, Foundation Press, New York (1995).
3. E. David, *The Scientific Examination of Documents – Methods and Techniques*, 2nd Edition, Taylor & Francis, Hants (1997).

FRS19S03	Forensic Science and Society	L	T	P	C
		2	0	0	2

Course Outcome(s) After completing this course, the student will be able to recognize:	
CO1	Importance of forensic engineering.
CO2	The role graphics and simulations in solving crime cases.
CO3	Importance of forensic archeology.
CO4	Importance of forensic intelligence
CO5	Managing serial crimes using forensic intelligence.

Unit-I: Forensic Engineering **6 Hrs**

Role of mechanical, electronics and computer engineers in forensic science. Accident investigations. Failure of signaling and control systems. Ergonomics.

Unit-II: Graphics and Simulations **6 Hrs**

Applications of animations, simulations and digital imaging in solving crime cases. Episodes involving fire engineering.

Unit-III: Forensic Archeology **6 Hrs**

Role of forensic archeology. Searching the archeological site. Methods of digging the burial site. Recovery of remains. Documenting the recovered material. Preservation of remains.

Unit-IV: Forensic Intelligence **6 Hrs**

Role of forensic intelligence in crime analysis. Methods of crime analysis. Databases in forensic intelligence.

Unit-V: Management of Serial Crimes **6 Hrs**

Management of serial crimes by application of forensic intelligence.

Text Books:

O. Ribaux and P. Margot in *Encyclopedia of Forensic Sciences*, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Ed.), Academic Press, London (2000).

References:

1. J.F. Brown and K.S. Obenski, *Forensic Engineering – Reconstruction of Accidents*, C.C. Thomas, Springfield (1990).
2. E.W. Killam, *The Detection of Human Remains*, C.C. Thomas, Springfield (1990).
3. R.K. Noon, *Introduction to Forensic Engineering*, CRC Press, Boca Raton (1992).

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE)

FRS19R331	Digital Forensics	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to know:	
CO1	The basics of digital forensics.
CO2	The cases which fall under the purview of digital crimes.
CO3	The types of digital crimes.
CO4	Computer Forensics Investigations
CO5	The elements involved in investigation of digital crimes.

Unit-I: Fundamentals and Concepts **12 Hrs**

Fundamentals of computers Hardware and accessories – development of hard disk, physical construction, CHS and LBA addressing, encoding methods and formats. Memory and processor. Methods of storing data. Operating system. Software. Introduction to network, LAN, WAN and MAN.

Unit-II: Computer Crimes **12 Hrs**

Definition and types of computer crimes. Distinction between computer crimes and conventional crimes. Reasons for commission of computer crimes. Breaching security and operation of digital systems. Computer virus, and computer worm – Trojan horse, trap door, super zapping, logic bombs.

Unit-III: Classification of Computer Crimes **12 Hrs**

Types of computer crimes – computer stalking, pornography, hacking, crimes related to intellectual property rights, computer terrorism, hate speech, private and national security in cyber space. An overview of hacking, spamming, phishing and stalking.

Unit-IV: Computer Forensics Investigations **12 Hrs**

Seizure of suspected computer. Preparation required prior to seizure. Protocol to be taken at the scene. Extraction of information from the hard disk. Treatment of exhibits. Creating bit stream of the original media.

Unit-V: The Elements of Computer Crime Investigations **12 Hrs**

Collection and seizure of magnetic media. Legal and privacy issues. Examining forensically sterile media. Restoration of deleted files. Password cracking and E-mail tracking. Encryption and decryption methods. Tracking users.

Experiments: **30 Hrs**

4. To identify, seize and preserve digital evidence from crime scenes.
5. To detect deletions, obliterations and modifications of files using encase software.

6. To trace routes followed by e-mails and chats.
7. To identify the IP address of the sender of e-mails.
8. To demonstrate concealment techniques using cryptographic PGP.
9. To identify encrypted files.
10. To identify hidden files.
11. To use digital signatures for securing e-mail and online transactions.
12. To acquire data from PCs/laptops/HDDs/USBs, pen drives, memory cards and SIM cards.
13. To use symmetric and asymmetric keys for protection of digital record.
14. To carry out imaging of hard disks.

Text Books:

1. R.K. Tiwari, P.K. Sastry and K.V. Ravikumar, *Computer Crimes and Computer Forensics*, Select Publishers, New Delhi (2003).
2. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).

References:

1. C.B. Leshin, *Internet Investigations in Criminal Justice*, Prentice Hall, New Jersey (1997).
2. E. Casey, *Digital Evidence and Computer Crime*, Academic Press, London (2000).

FRS19R332	Economic Offences	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to understand:	
CO1	Basic economic and financial terminology.
CO2	Economic crimes in India are linked to several other crimes.
CO3	Applied Economics in processing evidence.
CO4	Types of common economic offences and their consequences.
CO5	Steps involved in mitigating economic crimes.

Unit-I: Taxonomy of Economic Offences/Criminogenic Factors **12 Hrs**

Fundamentals of economics in economic offences. Tax evasion. Excise duty evasion. Fraudulent bankruptcy. White collar crime. Economic exclusion. Black money. Corruption and bribery of public servants. Money laundering and hawala transactions. Insurance frauds. Corporate frauds. Bank frauds. Ponzi scheme. Pyramid scheme.

Unit-II: Illicit Trafficking **12 Hrs**

Illicit trafficking in contraband goods. Illicit trafficking in arms. Illicit trafficking in explosives. Illicit drug trafficking. Trafficking in human organs. Cultural objects trafficking. Racketeering in employment. Racketeering in false travel documents.

Unit-III: Applied Economics in Processing Evidence **12 Hrs**

Forensic accountancy and forensic auditing. Valuation of economic losses. Violation of Intellectual Property Rights.

Unit-IV: Laws Related to Economic Offences **12 Hrs**

Legislations to deal with different forms of economic offences. RBI Act. SEBI Act. Competition Commission of India Act. Credit card frauds.

Unit-V: Prevention of Economic Crimes **12 Hrs**

Enforcement agencies to deal with different forms of economic offences. International perspectives – measures adopted by FBI and INTERPOL. Case histories of economic offences.

Experiments: **30 Hrs**

1. To prepare a draft on fraudulent bankruptcy.
2. To cite a case of money laundering and hawala transactions in India and prepare a note on it.
3. To cite a case involving bank fraud and suggest measures to prevent such crimes.
4. To study a case involving illicit drug trafficking and trace the route by which the item was being smuggled.
5. To prepare a report on trafficking of heritage artefacts, including religious deities in India.
6. To study the applications of accounting software.
7. To study the applications of TELLY software.

8. To review the legislative measures to deal with a particular economic offence, identifying the loopholes and suggesting ways to plug the loopholes.
9. To prepare a schedule of national agencies involved in curbing economic offences. Outline their specific duties.

Text Books:

1. S.P. Green, *Lying, Cheating and Stealing: A Moral Theory of White Collar Crime*, Oxford University Press, Oxford (2006).
2. Indian Audit and Accounts department, *Audit of Fraud, Fraud Detection and Forensic Audit*, 2007.

References:s

1. R.V. Clarke, *Situational Crime Prevention: Successful Case Studies*, 2nd Edition, Criminal Justice Press, New York (1997).
2. G. Geis, R. Meier, L. Salinger (Eds.), *White-Collar Crime: Classic & Contemporary Views*, Free Press, New York (1995).
10. J. Reiman, *The Rich get Richer and the Poor get Prison*, Allyn & Bacon, Boston (1998).
11. State Crime Branch, Haryana, *Investigation of Economic Offences*.

FRS19R333	Forensic Psychology	L	T	P	C
		4	0	4	6

Course Outcomes:	After studying this paper the students will know
CO1	The overview of forensic psychology and its applications.
CO2	The legal aspects of forensic psychology.
CO3	The significance of criminal profiling.
CO4	The importance of psychological assessment in gauging criminal behavior.
CO5	The tools and techniques required for detection of deception.

Unit-I: Basics of Forensic Psychology **12Hrs**

Definition and fundamental concepts of forensic psychology and forensic psychiatry.

Unit-II: Legal Aspects of Forensic Psychology **12Hrs**

Psychology and law. Ethical issues in forensic psychology. Assessment of mental competency. Mental disorders and forensic psychology. Psychology of evidence – eyewitness testimony, confession evidence.

Unit-III: Criminal Profiling **12Hrs**

Criminal profiling. Psychology in the courtroom, with special reference to Section 84 IPC.

Unit-IV: Psychology and Criminal Behavior **12Hrs**

Psychopathology and personality disorder. Psychological assessment and its importance. Serial murderers. Psychology of terrorism. Biological factors and crime – social learning theories, psycho-social factors, abuse. Juvenile delinquency – theories of offending (social cognition, moral reasoning), Child abuse (physical, sexual, emotional), juvenile sex offenders, legal controversies.

Unit-V: Detection of Deception **12Hrs**

Tools for detection of deception – interviews, non-verbal detection, statement analysis, voice stress analyzer, hypnosis. Polygraphy – operational and question formulation techniques, ethical and legal aspects, the guilty knowledge test. Narco analysis and brain electrical oscillation signatures – principle and theory, ethical and legal issues.

Experiments: **30 Hrs**

1. To cite a crime case where legal procedures pertaining to psychic behavior had to be invoked.
2. To prepare a report on relationship between mental disorders and forensic psychology.
3. To review a crime case involving serial murders. Comment on the psychological traits of the accused.
4. To cite a crime case involving a juvenile and argue for and against lowering the age for categorizing an individual as juvenile.
5. To study a criminal case in which hypnosis was used as a means to detect deception.
6. To prepare a case report on thematic appreciation test.

7. To prepare a case report on Minnesota multiphasic personality inventory test.
8. To prepare a case report on thematic appreciation test.
9. To prepare a case report on word association test.
10. To prepare a case report on Bhatia's battery of performance test of intelligence.
11. To cite a criminal case in which narco analysis was used as a means to detect deception.

Text Books:

1. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, The Foundation Press, Inc., New York (1995).

References:

1. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
2. J.C. DeLadurantey and D.R. Sullivan, *Criminal Investigation Standards*, Harper & Row, New York (1980).
3. J. Niehaus, *Investigative Forensic Hypnosis*, CRC Press, Boca Raton (1999).
4. E. Elaad in *Encyclopedia of Forensic Science, Volume 2*, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).

FRS19R334	Accident Investigations	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to:	
CO1	Background of vehicle accidents.
CO2	Analyze motor accidents.
CO3	Assess the post-crash movement.
CO4	Systematic analysis if injuries in accidents.
CO5	Tachographic data analysis.

Unit-I: Motor Vehicle Accidents **12 Hrs**

Accident scene. Sources of forensic information. Eyewitness accounts. Extent of vehicle damage. Visibility conditions. Photographs of accident site.

Unit-II: Analysis of Motor Accidents **12 Hrs**

Estimation of speed. Tire marks, skid marks, scuff marks. Maintenance of vehicles. Abandoned vehicles. Importance of air bags. Railway accidents.

Unit-III: Accident Analysis **12 Hrs**

Post-crash movement. Collision model. Gauging driver's reaction. Occupants's kinematics.

Unit-IV: Analysis of Injuries **12 Hrs**

Types of injuries resulting from accident. Biomechanics of injuries. Hit and run investigations. Trace evidence at accident sites.

Unit-V: Tachographs **12 Hrs**

Forensic significance of tachograph data. Tachograph charts. Principles of chart analysis. Accuracy of speed record. Tire slip effects. Falsification and diagnostic signals. Route tracing.

Experiments: **30 Hrs**

1. To lift tire marks.
2. To study the pattern of skid marks.
3. To study the pattern of scuff marks.
4. To estimate the speed of the vehicle from skid marks.
5. To prepare a report on a major road accident.
6. To prepare a report on a major train accident.

Text Books:

S.C. Batterman and S.D. Batterman in *Encyclopedia of Forensic Sciences*, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).

References:

1. T.S. Ferry, *Modern Accident Investigation and Analysis*, Wiley, New York (1988).
2. D. Lowe, *The Tachograph*, 2nd Edition, Kogan Page, London (1989).
3. T.L. Bohan and A.C. Damask, *Forensic Accident Investigation: Motor Vehicles*, Michie Butterworth, Charlottesville (1995).

FRS19R335	DNA Forensics	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to:	
CO1	The basic principle of DNA analysis.
CO2	The forensic significance of DNA typing.
CO3	The importance of short tandem repeats and restriction fragment length polymorphism in DNA technique.
CO4	Principles of parentage testing.
CO5	Report writing in DNA typing.

Unit-I: Basic Principles **12 Hrs**

DNA as biological blueprint of life. Extraction of DNA for analysis. Quantitation of DNA – yield gel quantitation and slot blot quantitation. Mitochondrial DNA – sequence analysis.

Unit-II: Forensic DNA Typing **12 Hrs**

Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence.

Unit-III: Short Tandem Repeat (STR) in DNA Technique **12 Hrs**

Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci. Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results. Touch DNA.

Unit-IV: Parentage Testing **12 Hrs**

Principles of heredity. Genetics of paternity. DNA testing in disputed paternity. Mandelian laws of parentage testing. Mathematical basis of parentage identification. Missing body cases. Reference populations and databases.

Unit-V: Report Writing **12 Hrs**

Role of DNA typing in identifying unrecognizable bodies.Allele frequency determination. Hardy-Weinberg law. Probability determination in a population database.

Experiments: **30 Hrs**

1. To carry out the separation of amino acids by thin layer chromatography.
2. To carry out *extraction of DNA from body fluids.*
3. To preparation of gel plates for electrophoresis.
4. To carry out electrophoresis for separation of enzymes.
5. To prepare a report on the role of DNA typing in solving paternity disputes.

Text Books:

W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

References:

1. J.M. Butler, *Forensic DNA Typing*, Elsevier, Burlington (2005).
2. K. Inman and N. Rudin, *An Introduction to Forensic DNA Analysis*, CRC Press, Boca Raton (1997).
3. H. Coleman and E. Swenson, *DNA in the Courtroom: A Trial Watcher's Guide*, GeneLex Corporation, Washington (1994).

FRS19R336	Crime and Society	L	T	P	C
		4	0	4	6

Course Outcomes:	After studying this course the students will be familiar with
CO1	The importance of criminology.
CO2	The causes of criminal behavior.
CO3	The significance of criminal profiling to mitigate crime.
CO4	The consequences of crime in society.
CO5	The elements of criminal justice system.

Unit-I: Basics of Criminology **12Hrs**

Definition, aims and scope. Theories of criminal behavior – classical, positivist, sociological. Criminal anthropology. Criminal profiling. Understanding modus operandi. Investigative strategy. Role of media.

Unit-II: Criminal Behaviour **12Hrs**

Elements, nature, causes and consequences of crime. Deviant behavior. Hate crimes, organized crimes and public disorder.

Unit-III: Criminal Profiling **12Hrs**

Domestic violence and workplace violence. White collar crimes Victimology. Juvenile delinquency.

Unit-IV: Crime and Society **12Hrs**

Social change and crime. Psychological Disorders and Criminality. Situational crime prevention.

Unit-V: Criminal Justice System **12Hrs**

Broad components of criminal justice system. Policing styles and principles. Police's power of investigation. Filing of criminal charges. Community policing. Policing a heterogeneous society. Correctional measures and rehabilitation of offenders. Human rights and criminal justice system in India.

Experiments: **30 Hrs**

1. To review past criminal cases and elucidate which theory best explains the criminal behavior of the accused.
2. To review crime cases where criminal profiling assisted the police to apprehend the accused.
3. To cite examples of crime cases in which the media acted as a pressure group.
4. To evaluate the post-trauma stress amongst victims of racial discrimination.
5. To correlate deviant behavior of the accused with criminality (take a specific example).
6. To evaluate victimology in a heinous crime.
7. To examine a case of juvenile delinquency and suggest remedial measures.
8. To evaluate how rising standards of living affect crime rate.
9. To review the recommendations on modernization of police stations and evaluate how far these have been carried out in different police stations.

10. To visit a 'Model Police Station' and examine the amenities vis-à-vis conventional police stations.
11. To examine steps being taken for rehabilitation of former convicts and suggest improvements.
12. To prepare a report on interrogation cells and suggest improvements.

Text Books:

1. S.H. James and J.J. Nordby, *Forensic Science: An Introduction to Scientific and Investigative Techniques*, 2nd Edition, CRC Press, Boca Raton (2005).
2. D.E. Zulawski and D.E. Wicklander, *Practical Aspects of Interview and Interrogation*, CRC Press, Boca Raton (2002).

References:

1. R. Saferstein, *Criminalistics*, 8th Edition, Prentice Hall, New Jersey (2004).
2. J.L. Jackson and E. Barkley, *Offender Profiling: Theory, Research and Practice*, Wiley, Chichester (1997).
3. R. Gupta, *Sexual Harassment at Workplace*, LexisNexis, Gurgaon (2014).

FRS19R337	Forensic Anthropology	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to know:	
CO1	Importance of forensic anthropology in identification of persons
CO2	Different techniques of facial reconstruction and their forensic importance.
CO3	Significance of somatoscopy and somatometry.
CO4	Concepts related to facial reconstruction.
CO5	Applications of somatoscopy and somatometry.

Unit-I: Significance of Forensic Anthropology **12 Hrs**

Scope of forensic anthropology. Study of human skeleton. Nature, formation, and identification of human bones. Determination of age, sex, stature from skeletal material.

Unit-II: Personal Identification – Somatoscopy **12 Hrs**

Somatoscopy – observation of hair on head, forehead, eyes, root of nose, nasal bridge, nasal tip, chin, Darwin's tubercle, ear lobes, supra-orbital ridges, physiognomic ear breadth, circumference of head. Scar marks and occupational marks.

Unit-III: Personal Identification –Somatometry **12 Hrs**

Somatometry – measurements of head, face, nose, cheek, ear, hand and foot, body weight, height. Indices - cephalic index, nasal index, cranial index, upper facial index.

Unit-IV: Facial Reconstruction **12 Hrs**

Portrait Parle/ Bertillon system. Photofit/identi kit. Facial superimposition techniques. Cranio facial super imposition techniques – photographic super imposition, videosuperimposition, Roentgenographic superimposition.

Unit-V: Application of Somatoscopy and Craniometry **12 Hrs**

Use of somatoscopic and craniometric methods in reconstruction. Importance of tissue depth in facial reconstruction. Genetic and congenital anomalies – causes, types, identification and their forensic significance.

Experiments: **30 Hrs**

1. To determine of age from skull and teeth.
2. To determine of sex from skull.
3. To determine sex from pelvis.
4. To study identification and description of bones and their measurements.
5. To investigate the differences between animal and human bones.
6. To perform somatometric measurements on living subjects.
7. To carry out craniometric measurements of human skull.
8. To estimate stature from long bone length.
9. To conduct portrait parley using photofit identification kit.

Text Books:

D. Ubelaker and H. Scammell, *Bones*, M. Evans & Co., New York (2000).

References:

1. M.Y. Iscan and S.R. Loth, The scope of forensic anthropology in, *Introduction to Forensic Sciences*, 2nd Ed., W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
2. S.Rhine, *Bone Voyage: A Journey in Forensic Anthropology*, University of Mexico Press, Mexico (1998).

FRS19R338	Forensic Medicine	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to realize:	
CO1	The duties of the first responding officer who receives a call on homicide or suicide case.
CO2	The steps involved in processing the death scene.
CO3	The process of collecting and documenting the evidences in death cases.
CO4	The importance of autopsy.
CO5	The importance of forensic odontology.

Unit-I: Death Investigations **12 Hrs**

Fundamental aspects and scope of forensic medicine. Approaching the crime scene of death. Obtaining first hand information from the caller. Rendering medical assistance to the victim, if alive. Protecting life. Recording dying declaration. Identifying witnesses and, if possible, suspect. Interviewing onlookers and segregating possible witnesses. Suspect in custody – initial interrogation and searching for evidence. Miranda warning card.

Unit-II: Crime Scene Management in Death Cases **12 Hrs**

Assessing the crime scene. Request for forensic team. Importance of command post and log book. Management of crowd and media. Importance of taking notes. Items to be a part of noting. Documenting the death scene.

Unit-III: Processing the Evidence **12 Hrs**

Processing evidence. Evaluation of injuries. Importance of canvass form. Indexing the death investigation. Handling buried body cases – search for buried bodies, methods of exhumation. Suicide cases – evaluating the type of injuries, gauging the psychological state of victim, suicide notes.

Unit-IV: Autopsy **12 Hrs**

Forensic pathology. Medico-legal aspects of death. Causes of death. Determination of time since death. Investigation of sexual offences. Death by drowning. Injuries. Types and classification of injuries. Antemortem and post mortem injuries. Aging of injuries. Artificial injuries.

Unit-V: Forensic Odontology **12 Hrs**

Development, scope and role of forensic odontology in mass disaster and anthropology. Types of teeth and their comparative anatomy. Bite marks. Forensic significance of bite marks. Collection, preservation and photography of bite marks evidence. Legal aspects of bite marks. Estimation of age from teeth.

Experiments: **30 Hrs**

1. To design a questionnaire for the first responder to the death scene.
2. To design a protocol to deal with the media at the crime scene.
3. To design a checklist for the forensic scientists at the death scene.

4. To design a canvass form giving description of an unidentified victim.
5. To analyze and preserve bite marks.

Text Books:

1. T. Bevel and R.M. Gardner, *Bloodstain Pattern Analysis*, 3rd Edition, CRC Press, Boca Raton (2008).
2. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013).

References:

1. K. Smyth, *The Cause of Death*, Van Nostrand and Company, New York (1982).
2. M. Bernstein, Forensic odontology in, *Introduction to Forensic Sciences*, 2nd Ed., W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
3. J. Dix, *Handbook for Death Scene Investigations*, CRC Press, Boca Raton (1999).
4. H.B. Baldwin and C.P. May in, *Encyclopedia in Forensic Science*, *Volume 1*, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).
5. V.J. Geberth, *Practical Homicide Investigation*, CRC Press, Boca Raton (2006).

FRS19R339	Questioned Documents	L	T	P	C
		4	0	4	6

Course Outcome(s) After completing this course, the student will be able to understand:	
CO1	The importance of examining questioned documents in crime cases.
CO2	The tools required for examination of questioned documents.
CO3	The features of comparison process.
CO4	The significance of comparing hand writing samples.
CO5	The importance of detecting frauds and forgeries by analyzing questioned documents.

Unit-I: Nature and Scope of Questioned Documents **12 Hrs**

Definition of questioned documents. Types of questioned documents. Preliminary examination of documents.

Unit-II: Tools for Examining Questioned Documents **12 Hrs**

Basic tools needed for forensic documents' examination – ultraviolet, visible, infrared and fluorescence spectroscopy, photomicrography, microphotography, visible spectral comparator, electrostatic detection apparatus. Determining the age and relative age of documents.

Unit-III: Comparison of Documents **12 Hrs**

Comparison of handwriting. Development of individuality in handwriting. Natural variations and fundamental divergences in handwritings. Class and individual characteristics. Merits and demerits of exemplar and non-exemplar samples during comparison of handwriting.

Unit-IV: Comparative Procedure of Handwriting **12 Hrs**

Standards for comparison of handwriting. Comparison of paper, ink, printed documents, typed documents, Xeroxed documents.

Unit-V: Forgeries **12 Hrs**

Alterations in documents, including erasures, additions, over-writings and obliterations. Indented and invisible writings. Charred documents. Examination of counterfeit Indian currency notes, passports, visas and stamp papers. Disguised writing and anonymous letters.

Experiments: **30 Hrs**

1. To identify handwriting characters.
2. To study natural variations in handwriting.
3. To compare handwriting samples.
4. To detect simulated forgery.
5. To detect traced forgery.
6. To study the line quality defects in handwriting samples.
7. To examine the security features of currency notes, passports and plastic money.
8. To study alterations, obliterations and erasures in handwriting samples.
9. To cite a case wherein Section 45 of Indian Evidence Act was invoked, seeking expert opinion for authentication of handwriting and/or signatures.

10. To cite a case wherein Section 489A of the Indian Penal Code was invoked in context of fake currency.

Text Books:

R.N. Morris, *Forensic Handwriting Identification: Fundamental Concepts and Principles*, Academic Press, London (2000).

References:

1. O. Hilton, *Scientific Examination of Questioned Documents*, CRC Press, Boca Raton (1982).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, *Scientific Evidence in Civil and Criminal Cases*, 4th Edition, Foundation Press, New York (1995).
3. E. David, *The Scientific Examination of Documents – Methods and Techniques*, 2nd Edition, Taylor & Francis, Hants (1997).

FRS19R399	Project / Dissertation	L	T	P	C
		4	0	4	6

The dissertation will be based on a research topic in Forensic Science/Criminology. The topic will be assigned in consultation with police and forensic science establishments, giving due consideration to the problem areas faced by these institutions. The students will be expected to undertake extensive field work, in collaboration with mobile police laboratories.